Renewable and Sustainable Energy Reviews 16 (2012) 4365–4369

Contents lists available at SciVerse ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

The impact of energy consumption and CO_2 emission on the economic and financial development in 19 selected countries

Usama Al-mulali*, Che Normee Binti Che Sab

Economic Programe, Universiti Sains Malaysia, 11800 Penang, Malaysia

ARTICLE INFO

Article history:
Received 19 September 2011
Received in revised form
6 May 2012
Accepted 8 May 2012
Available online 20 June 2012

Keywords:
Energy consumption
CO_2 emission
Economic development
Financial development
Panel data analysis

ABSTRACT

This study investigated the impact of energy consumption on the economic and financial development in 19 countries. These countries were selected due to the fact that the financial development indicators contribute an important share to their total GDP. The panel model was employed taking the period of 1980 to 2008. The results show that energy consumption enables these countries to achieve high economic and financial development. However, the high development that these countries have achieved in the late three decades increased the CO_2 emission. It is important that these countries should reduce the level of pollution through utilizing energy protection policies, such as rationing energy consumption and controlling carbon dioxide emissions or increasing the share of clean energy of their total energy consumption.

Contents

1. Introduction

In the 21th century a number of researchers such as Shumpeter [1], Goldsmith [2], McKinnon [3], and Shaw [4] found a strong relationship between the financial development and economic growth. Those researchers found that the financial development can help to achieve stable economic growth, increase the country's saving, reduce the cost of information, and monitor costs. It can also increase the business opportunities, the efficiency of investment, the exchange of goods and services, and improves the technological progress. However, in recent years, a number of studies have found a strong link between the energy consumption, CO_2 emissions, and the financial development. Thus, the main goal of this study is to investigate whether the relationship is present between the financial development, total primary energy consumption, and CO_2 emissions in 19 countries, namely, Antigua and Barbuda, Australia, Canada, China, Cyprus, Denmark, Iceland, Japan, South Korea, Malaysia, Malta, New Zealand, South Africa, St. Kitts and Nevis, Sweden, Switzerland, Thailand, United Kingdom, and the United States. Based on the world development indicators (WDI); the financial development indicators namely Broad money, Domestic credit provided by the banking sector, and the Domestic credit to the private sector basically contributes an important share to their total GDP. In addition, these countries increased their energy consumption over the last 30 years consuming more than 45% of the world total primary energy consumption and producing 57% of the world CO_2 emission. In addition, the study will examine the long run and the causal relationship between energy consumption, CO_2 emissions and economic development by using GDP per capita based on the purchasing power parity as an indicator of economic development.

A large number of studies investigated the relationship between energy consumption, CO_2 emission, and economic

* Corresponding author. +60174587786.
E-mail addresses: usama_81z@yahoo.com (U. Al-mulali), csnormee@usm.my (C.N. Binti Che Sab).

1364-0321/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.rser.2012.05.017

growth. As an example, Fallahi [5] found a significant bi-directional causal relationship between energy consumption and growth in the US. Similar results were found in the African countries [6]. On the other hand, Zhang-wei and Xun-gang [7] found a one way causal relationship from energy consumption to GDP growth in China. Ozturk and Acaravci [8] found a long run relationship between energy consumption, CO_2 emission and growth at 5% level of significance in Turkey. Moreover, there was no evidence of a short long causal relationship from energy consumption per capita and CO_2 emission to the GDP per capita. In the BRIC countries, a positive long run relationship between energy consumption and CO_2 emission, a long run bi-directional causal relationship between energy consumption and CO_2 emission and between energy consumption and output, and a short run causal relationship from energy consumption and CO_2 emission to output growth [9] were found. Similar results were found in China by Wang et al. [10] and in Brazil by Pao and Tsai [11]. In addition, Xiumei et al. [12] found a one way causal relationship from GDP to energy consumption and CO_2 emission in China. In the United States, it was found that the level of income does not have a causal relationship relationship with CO_2 emission but energy consumption does; thus, income may not become a solution to the environmental problems [13]. Halicioglu [14] found a long run relationship between energy consumption, CO_2 emission, income, and foreign trade in Turkey. Alam et al. [15] found a long run bi-directional causal relationship between energy consumption and CO_2 emission, while there was no evidence of a causal relationship from energy consumption and CO_2 emission to real income in India. Lotfalipour et al. [16] found a one way short run causal relationship from economic growth and petroleum products and natural gas consumption to CO_2 emission in Iran and no causal relationship from fossil fuel consumption to CO_2 emission in the long run. In China, one way causal relationship from economic growth to energy consumption and from energy consumption to CO_2 emission was found. However, neither energy consumption nor CO_2 emission has a causal relationship with economic growth [17]. In the European Union countries, a one way causal relationship running from CO_2 emission to energy consumption was found while there is no causal relationship between income and CO_2 emission [18]. Li et al. [19] found a long run positive relationship between GDP per capita and energy consumption that 1% increase in GDP per capita will increase energy consumption and CO_2 emission by 0.5% and 0.41%, respectively. Pao [20] found a long run cointegration and a one way causal relationship from economic growth to electricity consumption in Taiwan. In Russia, it was found that CO_2 emission is elastic with energy consumption and inelastic with output. A bi-directional causal relationship between energy consumption CO_2 emission and output growth was also found [21]. Pao and Tsai [22] found a strong bi-directional causal relationship between CO_2 emission and FDI and a one way causal relationship from output to FDI in the BRIC countries. Acaravci and Ozturk [23] found a long run relationship between energy consumption per capita, CO_2 emissions per capita and GDP per capita and a positive causal relationship between them in Europe was also found. A one way causal relationship was found from GDP growth to energy consumption in newly industrialized countries [24], Al-mulali [25] found a long run relationship and causal relationship between oil consumption, CO_2 emission, and economic growth in MENA countries.

Another group of studies found a relationship between energy consumption and economic development. You [26], for instance, found that the clean and renewable energy consumption significantly increases China's genuine savings, thus, the renewable energy consumption promotes sustainable development. In addition, it was found that solid energy consumption is more likely to benefit only GDP growth. Apergis and Payne [27] found a significant long run and short run causal relationship between electricity consumption and economic development in both high and upper middle income countries. A one way short run and bi-directional long run causal relationship from electricity consumption to economic development in lower-middle income countries was also found. Moreover, a one way causal relationship from electricity consumption to economic development in low income countries was present. Ang [28] found that energy consumption and CO_2 emission are positively related to economic development in Malaysia. Similar results were found in Sub-Sahara African countries [29] and China [30]. Kiliç and Kaya [31] found that the recent development in Turkey increased both energy consumption and CO_2 emission in the last 20 years.

The relationship between energy consumption, CO_2 emission and the financial development was also investigated. Tamazian et al. [32] found that a high degree of financial development reduces the environmental degradation in the BRIC countries. It was also found that the financial liberalization and openness play an important role in the reduction of CO_2 emission. Sadorsky [33] found a positive and significant relationship between the financial development and energy consumption in Central and Eastern European countries. Zhang et. al [34] found similar results between energy consumption and the stock market development in China. Jalil and Feridun [35] found out that financial development led to a decrease in CO_2 emission in China, while income, energy consumption, and trade openness have led to an increase in CO_2 emission. Zhang [36] found different results in China where the financial development is an important driver in increasing CO_2 emission. The same results were found in emerging countries by Sadorsky [37]. In addition, it was found the financial development played an important role in increasing both energy consumption and the CO_2 emission in the Sub Saharan African countries [38] and the same results were found in Tunisia by Shahbaz and Lean [39].

2. Methodology and results

This study will use the panel model during the period of 1980 to 2008 due to its many advantages Baltagi [40]. Since the main goal of this study is to examine the relationship between energy consumption, CO_2 emission, financial development (broad money, domestic credit provided by banking sector, and the domestic credit to private sector), and economic development (GDP per capita based on the purchasing power parity), four models will be employed. These models can be specified as follows:

$$\mathrm{BM}_{it} = \alpha + \beta_1 \mathrm{ECP}_{it} + \beta_2 \mathrm{EMP}_{it} + \varepsilon_{it} \tag{1}$$

$$\mathrm{DCPC}_{it} = \alpha + \beta_1 \mathrm{ECP}_{it} + \beta_2 \mathrm{EMP}_{it} + \varepsilon_{it} \tag{2}$$

$$\mathrm{DCPS}_{it} = \alpha + \beta_1 \mathrm{ECP}_{it} + \beta_2 \mathrm{EMP}_{it} + \varepsilon_{it} \tag{3}$$

$$\mathrm{GDPP}_{it} = \alpha + \beta_1 \mathrm{ECP}_{it} + \beta_2 \mathrm{EMP}_{it} + \varepsilon_{it} \tag{4}$$

where α is the intercept, β_1 and β_2 are the slope coefficients of the models, t is time i is the cross section unit (ith country). BM is the broad money measured in billions constant US dollars. DCPC is the domestic credit provided by banking sector measured in billions of US dollars. DCPS is the domestic credit to private sector measured in billions of US dollars. GDPP is the GDP per capita based on the purchasing power parity measured in constant US dollars. ECP is the total primary energy consumption per capita measured million Btu per person. EMP is the per capita carbon dioxide emissions from the consumption of energy measured in metric tons of carbon dioxide per person.

The Broad money, Domestic credit provided by banking sector, the Domestic credit to private sector, and GDP per capita based on the purchasing power parity are taken from the World Development Indicators (WDI) [41]. The total primary energy consumption per capita and the per capita carbon dioxide emissions are taken from Energy Information Administration (EIA) [42].

This study will use the Im, Pesaran, and Shin, and the Fisher-ADF and PP panel unit root test to examine whether the variables contain a panel unit root. If the variables contain a panel unit root, the panel Pedroni cointegration test will be used to find out whether the long run relationship between the variables is present. If the variables are cointegrated, Granger causality based on the vector error-correction model will be tested to find out whether a long run or a short causal relationship is present between the variables.

2.1. Panel unit root test

The Im, Pesaran, and Shin, and the Fisher-ADF and PP tests allow for individual unit root processes, so ρ_i may vary across the cross-sections. These tests are basically characterized by a combination of individual unit root tests to derive a panel specific result. These unit root tests specify a separate ADF regression for each cross section:

$$\Delta y_{it} = \alpha y_{it-1} \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + X'_{it}\ \delta + \varepsilon_{it} \tag{5}$$

The null hypothesis can be written as follows:

$H_0: \ \alpha = 0 \quad$ for all i

The alternative hypothesis can be written as follows:

$$H_1: \begin{cases} a_i = 0 & for \quad i = 1,2,3,\ldots,N_1 \\ \alpha_i < 0 & for \quad i = N+1, \quad N+2,\ldots,N \end{cases}$$

where the i may be reordered as necessary which may be interpreted as a non-zero fraction of the individual processes is stationary. Table 1 below reviews the panel unit root test results and shows that all the variables are stationary at the first difference rejecting the null hypothesis at 1% level of significance. This indicates that the variables contain a panel unit root.

Table 1
Panel unit root test results.

Variable	Level		First difference	
	Intercept	Intercept and trend	Intercept	Intercept and trend
Im, Pesaran and Shin W-stat				
BM	11.1935	5.71148	3.62916***	5.54422***
DCPC	10.2246	5.00508	5.48872***	5.82580***
DCPS	9.61257	3.66906	6.56950***	7.04121***
GDPP	5.60752	0.83357	6.99848***	5.18964***
ECP	2.57262	3.01757	10.9153***	10.3903***
EMP	10.8796	2.30075	6.20154***	5.34021***
ADF—Fisher Chi-square				
BM	3.83512	23.4891	92.4816**	109.786***
DCPC	6.95056	14.3590	106.704***	107.147***
DCPS	8.13438	21.3393	118.729***	123.414***
GDPP	8.63271	34.1861	123.142***	90.6610***
ECP	28.5436	27.7113	203.505***	179.722***
EMP	4.03311	26.1501	111.341***	92.9422***
PP—Fisher Chi-square				
BM	3.11257	10.6964	76.1234***	81.1851***
DCPC	9.96926	15.1049	200.766***	426.689***
DCPS	5.59870	14.5696	188.116***	238.549***
GDPP	5.23675	17.6831	156.102***	122.952***
ECP	31.6648	47.9325	363.016***	645.393***
EMP	3.69285	16.4672	140.647***	129.112***

Note: the unit root test where done with individual trends and intercept for each variable, the optimal lag length were selected automatically using the Schwarz information criteria, ***indicates significance at 1% level.

2.2. Pedroni (Engle-Granger based) cointegration tests

Since the variables contain a panel unit root, the Pedroni cointegration test will be used. Pedroni proposes several tests for cointegration that allow for heterogenous intercepts and trend coefficients across cross-sections. Consider the following regression:

$$y_{it} = \alpha_i + \delta_{it} + \beta_1 x_{1,it} + \beta_2 x_{2it} + \cdots + \beta_{ki} x_{kit} + \varepsilon_{it} \tag{6}$$

where $t=1, \ldots, T$; $i=1, \ldots, N$; $j=1, \ldots, k$; and y and x are assumed to be integrated of order 1 i.e., $I(1)$. The parameters α_i and δ_i are individual entity and time effects, respectively which may be set to zero if desired. Under the null hypothesis of no cointegration, the residuals ε_{it} will be $I(1)$. To conduct the cointegration test, we need to obtain the residuals from Eq. (5.22) and then test whether the residuals are $I(1)$ by running the following auxiliary regression for each cross-section:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + u_{it} \tag{7}$$

or

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + + \sum_{j=1}^{p_i} \theta_{ij} \Delta e_{it-j} + v_{it} \tag{8}$$

Pedroni constructs various statistics for testing the null hypothesis of no cointegration i.e., H_0: $\rho_i = 1$ for all i, where p_i is the coefficient of the estimated residual. There are two different alternative hypotheses. The first one states that the cointegrating vector $\boldsymbol{\beta_i}$ is homogenous i.e., H_1: $\rho_i = \rho < 1$ for all i which Pedroni terms the within-dimension or panel statistics test. The second one states that the cointegrating vector $\boldsymbol{\beta_i}$ is heterogenous i.e., H_1: $\rho_i < 1$ for all i which Pedroni terms the between-dimension or group statistics test. The Pedroni panel cointegration statistics are constructed from the residuals, either from Eqs. (7) and (8). A total of seven statistics with varying size and power for different N and T are generated. Pedroni shows that the standardized statistics is asymptotically normally distributed,

$$\frac{N'_{N,T} - \mu\sqrt{N}}{\sqrt{\nu}} \rightarrow N(0,1) \tag{9}$$

where u and ν are the Monte Carlo generated adjustment terms.

These cointegration statistics are the Panel ν-statistics, Panel p-statistics, Panel t-Statistic (non-parametric), Panel t-Statistic (parametric), Group ρ-statistics, Group t-statistics (non-parametric), and the Group statistics (parametric). The first four cointegration statistics refer to the within-dimension or panel statistics test and the last three refer to the between dimension or group statistics test.

Table 2 reviews the Pedroni cointegration test results for the BM, DCPC, DCPS, and the GDPP model. The results show that most of the statistics are significant rejecting the null hypothesis of no cointegration. These results indicate that the long run relationship is present between energy consumption, CO_2 emission, and the economic and the financial development indicators in the countries under investigation.

2.3. Panel Granger causality

Since the variables are cointegrated, the panel Granger causality based on the vector error-correction model will be used to investigate the temporal short-run causality between the

Table 2
Pedroni cointegration test results.

	BM model	DCPC model	DCPS model	GDPP model
Alternative hypothesis: common AR coefs. (within-dimension)				
Panel *v*-statistic	3.773960***	31.26003***	20.43334***	−0.494736
Panel rho-statistic	1.679162	−0.090186	0.556655	0.506061
Panel PP-statistic	1.086961	−3.606613***	−3.271510***	−1.567691**
Panel ADF-statistic	−2.319593**	−4.524323***	−4.401479***	−0.624333
Panel *v*-statistic (weighted statistic)	2.712854**	5.346602***	5.001108***	−0.954853
Panel rho-statistic (weighted statistic)	1.889913	0.077996	0.158297	−0.211380
Panel PP-statistic (weighted statistic)	3.519149**	−1.572815**	−2.071165**	−2.545163***
Panel ADF-statistic (weighted Statistic)	−0.416522	−2.564424**	−2.944482***	−1.427024**
Alternative hypothesis: individual AR coefs. (between-dimension)				
Group rho-statistic	3.452823	2.017262	2.059818	1.949102
Group PP-statistic	6.880112**	−0.084970	−0.751968	−0.900172*
Group ADF-statistic	−1.160824*	−1.104082*	−1.900669**	−3.256867**

***, **,* donate significance at 1%, 5% and 10%, we use the automatic selection based on the Schwarz to choose the optimal lag length.

Table 3
Panel Granger causality test results.

	ΔBM	**ΔDCPC**	**ΔDCPS**	**ΔGDPP**	**ΔECP**	**ΔEMP**	**Ect**
ΔBM	–	13.096***	41.592***	–	3.259***	0.398	0.911
ΔDCPC	3.543***	–	252.503***	–	0.353	0.326	3.497***
ΔDCPS	223.233***	8.140***	–	–	0.476	0.332	4.187***
ΔGDPP	–	–	–	–	1.444*	6.485***	1.484*
ΔECP	0.171	0.1533	0.218	0.916	–	42.678***	2.834**
ΔEMP	0.555	0.394	0.285	4.772***	40.823***	–	1.712**

Note: The null hypothesis is that there is no causal relationship between variables. Values in parentheses are *p*-values for Wald tests with a x^2 distribution. *Δ* is the first difference operator. ect (−1) represents the error correction term lagged one period. *** Indicate 1% and ** Indicate 5% significant level, *Δ* is the first difference operator.

variables. Short-run Granger causality is based on the *F*-test and χ^2 test. The long-run causal relationship based on the lagged error correction term in the VECM, based on the t test. The following two Eq. (10) introduce the Granger causality model with uniform lag length:

$$\Delta \mathrm{DEP}_{it} = \alpha_{it} + \beta_{it}\mathrm{ect}_{it-1} + \sum_{i=1}^{l} \xi_{it}\Delta \mathrm{DEP}_{it-1} + \sum_{i=1}^{l} \varphi_{it}\Delta \log(\mathrm{INDP})_{it-1} + \mu_{it} \tag{10}$$

DEP is the dependent variable, INDP is the independent variable, Δ is the first difference operator, α_{it} is the constant term, β_{it}, ξ_{it}, and φ_{it} are the parameters, ect_{it-1} is the lagged error correction term obtained from the cointegrating equation and μ_{it} is the white noise error.

Table 3 shows the Granger causality test results. A long run bi-directional causal relationship between the variables was found with the exception broad money based on the error correction term. In the short run, a bi-directional causal relationship between energy consumption and CO_2 emission, between Broad money, Domestic credit provided by banking sector, and the Domestic credit to private sector, and between CO_2 emission and GDP per capita was found while a one way causal relationship is present from energy consumption and CO_2 emission to broad money, from energy consumption to GDP per capita. The most important finding in the Granger causality test is that energy consumption affected both the economic and the financial development in the countries under investigation but only in the long run. However, the high development that these countries achieved in the last three decades increased both energy consumption and CO_2 emission. Moreover, in the short run energy consumption and CO_2 emission increased economic development based on its positive causal relationship with GDP per capita. It was also found that energy consumption increased one of the financial development indicators, namely broad money. Thus, energy consumption increased the economic and the financial development, but it caused CO_2 emission to rise.

3. Conclusion

This study examined the long run and the causal relationship between energy consumption, CO_2 emission, and the economic and financial development in 19 countries, namely Antigua and Barbuda, Australia, Canada, China, Cyprus, Denmark, Iceland, Japan, South Korea, Malaysia, Malta, New Zealand, South Africa, St. Kitts and Nevis, Sweden, Switzerland, Thailand, United Kingdom, and the United States. The panel model was used taking the period from 1980 to 2008. Out of the Pedroni cointegration test results, it was found that energy consumption and CO_2 emission have a log run relationship with the financial development indicator and the economic development indicator. Moreover, the Granger causality test results showed that both energy consumption and CO_2 emission affected both the financial and the economic development in the countries under investigation based on the long run causal relationship and the positive short run causal relationship. However, despite the fact that energy consumption helped these countries to achieve high economic and financial development, CO_2 emission was also increased in the same time. This increase in the level of pollution is due to the increase in fossil fuel consumption which plays more than 75% from total energy consumption in the investigated countries. Despite the fact that both energy consumption and CO_2 emission have a positive short run causal relationship with the economic development and a long run causal relationship with the economic and financial development, it is important to reveal that these countries utilize energy protection policies, such as rationing energy consumption and controlling carbon dioxide emissions or increase the share of clean energy of their total energy consumption to reduce the level of pollution.

References

[1] Shumpeter J. The Theory of Economic Development. Cambridge, MA, US: Harvard University Press; 1932.
[2] Goldsmith R. Financial Structure and Development. New York: Yale University Press; 1969.
[3] McKinnon R. Money and Capital in Economic Development. Washington, DC: Brookings Institution; 1973.
[4] Shaw E. Financial Deepening in Economic Development. New York: Oxford University Press; 1973.
[5] Fallahi F. Causal relationship between energy consumption (EC) and GDP: a Markov-switching (MS) causality. Energy 2011;36:4165–70.
[6] Eggoh J, Bangake C, Rault C. Energy consumption and economic growth revisited in African countries. Energy Policy 2011;39:7408–21.
[7] Zhang-wei Li, Xun-gang Z. Study on relationship of energy consumption and economic growth in China. Physics Procedia 2012;24:313–9.
[8] Ozturk I, Acaravci A. CO_2 emissions, energy consumption and economic growth in Turkey. Renewable and Sustainable Energy Reviews 2010;14: 3220–5.
[9] Pao H, Tsai C. CO_2 emissions, energy consumption and economic growth in BRIC countries. Energy Policy 2010;38:7850–60.
[10] Wang SS, Zhou DQ, Zhou P, Wang QW. CO_2 emissions, energy consumption and economic growth in China: a panel data analysis. Energy Policy 2011;39: 4870–5.
[11] Pao H, Tsai C. Modeling and forecasting the CO_2 emissions, energy consumption, and economic growth in Brazil. Energy 2011;36:2450–8.
[12] Xiumei,S, Min Z, Ming Z. Empirical Study on the Relationship between Economic.
[13] Soytas U, Sari R, Ewing B. Energy consumption, income, and carbon emissions in the United States. Ecological Economics 2007;62:482–9.
[14] Halicioglu F. An econometric study of CO_2 emissions, energy consumption, income and foreign trade in Turkey. Energy Policy 2009;37:1156–64.
[15] Alam M, Begum I, Buysse J, Rahman S. Dynamic modeling of causal relationship between energy consumption, CO_2 emissions and economic growth in India. Renewable and Sustainable Energy Reviews 2011;15:3243–51.
[16] Lotfalipour M, Falahi M, Ashena M. Economic growth, CO_2 emissions, and fossil fuels consumption in Iran. Energy 2010;35:5115–20.
[17] Zhang X, Cheng X. Energy consumption, carbon emissions, and economic growth in China. Ecological Economics 2009;68:2706–12.
[18] Soytas U, Sari R. Energy consumption, economic growth, and carbon emissions: challenges faced by an EU candidate member. Ecological Economics 2009;68:1667–75.
[19] Li F, Dong S, Li X, Liang Q, Yang W. Energy consumption-economic growth relationship and carbon dioxide emissions in China. Energy Policy 2011;39:568–74.
[20] Pao H. Forecast of electricity consumption and economic growth in Taiwan by state space modeling. Energy 2009;34:1779–91.
[21] Pao H, Yu H, Yang Y. Modeling the CO_2 emissions, energy use, and economic growth in Russia. Energy 2011:1–7.
[22] Pao H, Tsai G. Multivariate Granger causality between CO_2 emissions, energy consumption, FDI (foreign direct investment) and GDP (gross domestic product): Evidence from a panel of BRIC (Brazil, Russian Federation, India, and China) countries. Energy 2011;36:685–93.
[23] Acaravci A, Ozturk I. On the relationship between energy consumption, CO_2 emissions and economic growth in Europe. Energy 2010;35:5412–20.
[24] Hossain MD. Panel estimation for CO_2 emissions, energy consumption, economic growth, trade openness and urbanization of newly industrialized countries. Energy Policy 2011;39:6991–9.
[25] Al-mulali U. Oil consumption, CO_2 emission and economic growth in MENA countries. Energy 2011; DOI:10.1016/j.energy. 2011.07.048.
[26] You J. China's energy consumption and sustainable development: Comparative evidence from GDP and genuine savings. Renewable and Sustainable Energy Reviews 2011;15:2984–9.
[27] Apergis N, Payne J. A dynamic panel study of economic development and the electricity consumption-growth nexus. Energy Economics 2011;33:770–81.
[28] Ang J. Economic development, pollutant emissions and energy consumption in Malaysia. Journal of Policy Modeling 2008;30:271–8.
[29] Kebede E, Kagochi J, Jolly C. Energy consumption and economic development in Sub-Sahara Africa. Energy Economics 2010;32:532–7.
[30] Yuan C, Liu S, Fang Z, Xie N. The relation between Chinese economic development and energy consumption in the different periods. Energy Policy 2010;38:5189–98.
[31] Kiliç F, Kaya D. Energy production, consumption, policies, and recent developments in Turkey. Renewable and Sustainable Energy Reviews 2007;11:1312–20.
[32] Tamazian A, Chousa J, Vadlamannati K. Does higher economic and financial development lead to environmental degradation: evidence from BRIC countries. Energy Policy 2009;37:246–53.
[33] Sadorsky P. Financial development and energy consumption in central and Eastern European frontier economies. Energy Policy 2011;39:999–1006.
[34] Zhang Y, Fan J, Chang H. Impact of China's stock market development on energy consumption: an empirical analysis. Energy Procedia 2011;5: 1927–31.
[35] Jalil A, Feridun M. The impact of growth, energy and financial development on the environment in China: a cointegration analysis. Energy Economics 2011;33:284–91.
[36] Zhang Y. The impact of financial development on carbon emissions: An empirical analysis in China. Energy Policy 2011;39:2197–203.
[37] Sadorsky P. The impact of financial development on energy consumption in emerging economies. Energy Policy 2010;38:2528–35.
[38] Al-mulali U, Che Sab CN. The impact of energy consumption and CO_2 emission on the economic growth and financial development in the Sub Saharan African countries. Energy 2012;39:180–6.
[39] Shahbaz M, Lean H. Does financial development increase energy consumption? The role of industrialization and urbanization in Tunisia Energy Policy 2012;40:473–9.
[40] Baltagi B. Econometric Analysis of Panel Data. England: John Wiley & Sons Ltd; 2005.
[41] The World Bank. World Development Indicators. Washington, DC; 2012. 〈http://data.worldbank.org/data-catalog/world-development-indicators〉.
[42] Energy Information Administration (EIA). International Energy Statistics. Washington, DC; 2012. 〈http://www.eia.gov/countries/data.cfm〉.